

D.A.KOSSAKOVSKI, G.H.Bearman, J.L.Beauchamp¹, J.L.Kirschvink²

In-situ Experimental Science Group, Jet Propulsion Laboratory, California Institute of Technology, MS 306-336, 4800 Oak Grove Dr., Pasadena CA 91109, USA.

¹ Noyes Laboratory of Chemical Physics, MS 127-72, California Institute of Technology, Pasadena, CA 91125, USA.

² Division of Geological and Planetary Sciences, MS 170-25, California Institute of Technology, Pasadena, CA 91125, USA.

Spatially resolved chemical imaging is achieved by combining a fiber optic scanning probe microscope, SPM with laser induced breakdown spectroscopy, LIBS, in a single instrument, Chemical Imager. Elemental composition of surfaces can be mapped and correlated with topographical data. The experiment is conducted in air with minimal sample preparation. In a typical experiment surface topography is analyzed by scanning a sharp fiber optic probe across the sample using shear force feedback. The probe is then positioned over a feature of interest and pulsed radiation is delivered to the surface using a nitrogen laser. The pulse vaporizes material from the surface and generates a localized plasma plume. Optical emission from the plume is analyzed with a compact UV/VIS spectrometer. Ablation crater size is controlled by the amount of laser power coupled into the probe. Sampling areas with sub-micron dimensions are achieved by using reduced laser power.

An example of topography imaging of aluminum sample is shown in Figure 1. Typical LIBS spectrum from a single laser pulse delivered to this sample through a fiber probe is shown in Figure 2. Peaks corresponding to aluminum and alloy additives are present in the spectrum. Figure 3 shows small crater size from a single laser pulse delivered through the probe to the surface of polished basalt.

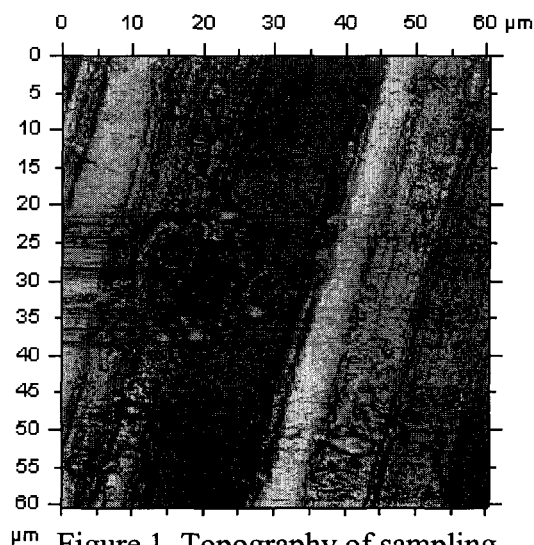


Figure 1. Topography of sampling crater on aluminum surface.

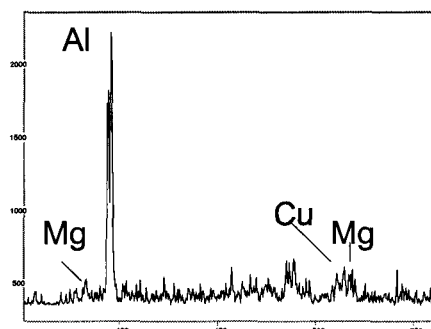


Figure 2. LIBS spectrum from aluminum sample in Figure 1.

The attractive features of this analytical methodology include minimal to no sample preparation, capability to perform studies in ambient environment, low cost, and adaptability to portable design. We believe that a wide variety of applications will benefit from using Chemical Imager instrumentation, including wafer contamination studies in semiconductor manufacturing, particle analysis in environmental problems, surface analysis in materials science, analysis of biological specimens, and in-situ exploration for planetary research.

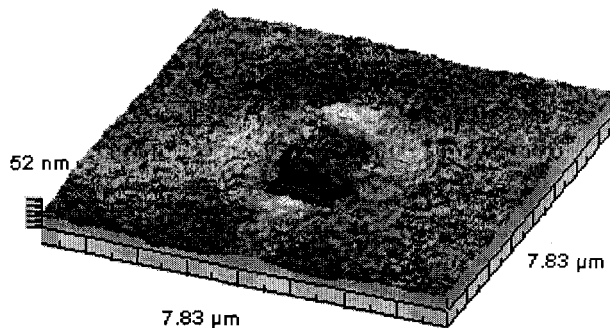


Figure 3. Topography of small crater size on polished basalt surface.